

REMARKS

Claims 1-3, 6-8 and 11-13 are pending in this application. By this Amendment, claims 1-3, 6-8 and 11-13 are amended, and claims 4-5, 9-10 and 14-15 are canceled. The independent claims are amended to even more clearly distinguish over the applied references. No new matter is added.

I. Overview of Claimed Subject Matter

One distinctive feature of the claimed subject matter is a relation between the range of an average particle diameter and Q_{\max} (Figs. 5-8, 10-13 and 15-19). For example, in Figs. 5-8, a desirable Q_{\max} (e.g., 8 or larger) when measured in the third harmonic mode of the vertical thickness vibration in a relatively high frequency range (e.g., 16-25 MHz, more specifically 24 MHz) is achieved by controlling the average particle diameter (to be within 1.3-4.2 μm) of the piezoelectric ceramic particles. Thus, the claimed subject matter provides a piezoelectric element having a suitable Q_{\max} for its application by controlling the average particle diameter of the piezoelectric ceramic particles of the piezoelectric element.

II. The Claims Are Patentable Over the Applied References**A. Tsukada**

The Office Action (1) rejects claims 1-4 and 6-9 under 35 U.S.C. §102(b) over Japanese Patent Publication No. 2001-220226 to Tsukada et al. (Tsukada); and (2) rejects claims 5 and 10 under 35 U.S.C. §102(b), or in the alternative, under 35 U.S.C. §103(a), over Tsukada. Applicants respectfully traverse the rejections.

Regarding independent claim 1, Tsukada fails to disclose (1) "an average particle diameter by the code length measuring method is 1.3 to 4.2 μm "; and (2) "a maximum value Q_{\max} of "Q" ($Q=|X|/R$, wherein "X" is reactance and "R" is resistance) between a resonant frequency and an antiresonant frequency with respect to a third harmonic wave of thickness

vertical vibration at 24 MHz is 8 or larger." Regarding independent claim 6, Tsukada fails to disclose (1) "1.4 to 4.2" and (2) "60 MHz is 6 or larger."

Tsukada discloses a piezoelectric ceramic including a bismuth layered compound containing M^{II} , Bi, Ti, Ln, and O; wherein M^{II} is at least one of Sr, Ba, and Ca; and Ln is at least one lanthanoid. The ceramic also contains $M^{II}Bi_4Ti_4O_{15}$ wherein $Ln/(Sr + Ln)$ satisfies $0 < Ln / (Sr + Ln) < 0.5$ and $4.000 < 4 Bi / Ti \leq 4.030$ (Solution).

Tsukada fails to disclose feature (1) above because Tsukada mentions an average particle diameter of the piezoelectric substance but does not disclose the narrower claimed range (paragraph [0020]). Tsukada fails to disclose feature (2) above because the piezoelectric element disclosed by Tsukada is required to have a mole ratio of $4Bi / Ti$ strictly within 4.000 to 4.030 for attaining excellent piezoelectric properties such as high Q_{max} (Solution).

Regarding dependent claim 2, Tsukada fails to disclose "wherein said $M^{II}Bi_4Ti_4O_{15}$ type crystal is expressed by a composition formula $(Sr_\alpha Ln_\beta)Bi_\gamma Ti_4O_{15}$ wherein "alpha" satisfies $\alpha = 1 - \beta$, " β " satisfies $0.01 \leq \beta \leq 0.50$ and " γ " satisfies $3.80 \leq \gamma \leq 4.50$." Regarding dependent claim 7, Tsukada fails to disclose "wherein said $M^{II}Bi_4Ti_4O_{15}$ type crystal is expressed by a composition formula $(Ca_{1-\beta} Ln_\beta)Bi_\gamma Ti_4O_{15}$, wherein " β " satisfies $0.01 \leq \beta \leq 0.5$ and " γ " satisfies $3.80 \leq \gamma \leq 4.20$."

Tsukada fails to disclose these features because, while the Office Action cites to Table 1 in Tsukada as disclosing these relationships, Table 1 only shows calculated values for " Q_{max} " based on the measured impedance values and "b".

For the foregoing reasons, Applicants request withdrawal of the rejections.

B. Itakura

The Office Action (1) rejects claims 11-14 under 35 U.S.C. §102(b) over Japanese Patent Publication No. 2003-335577 to Itakura et al. (Itakura); and (2) rejects claim 15 under

35 U.S.C. §102(b), or in the alternative, under 35 U.S.C. §103(a), over Itakura. Applicants respectfully traverse the rejections.

As an initial matter, Applicants note that the Office Action refers to Itakura by the lead inventor's first name Keisuke. Applicants refer to Japanese Patent Publication No. 2003-335577 by the inventor's surname Itakura herein.

Regarding independent claim 11, Itakura fails to disclose or suggest "an average particle diameter by the code length measuring method is 1.0 to 1.7 μm ; and a maximum value Q_{max} of " Q_n ($Q = |X|/R$, wherein " X " is reactance and " R " is resistance) between a resonant frequency and an antiresonant frequency with respect to the fundamental wave of thickness-shear vibration at 8 MHz is 23 is larger."

Itakura discloses a piezoelectric device containing a layered bismuth compound containing M^{II} (an element selected from the group consisting of Sr, Ba and Ca), Ln (at least a lanthanoid), Bi, Ti, and O, and further containing a crystal in the form of $M^{II}\text{Bi}_4\text{Ti}_4\text{O}_{15}$ wherein the atomic ratio of Sr, Ba and Ca in the M^{II} molecule is represented by x, y, and z, where in $x + y + z = 1$, $0 \leq x < 1$, $0 < y \leq 0.9$, and $0 \leq z < 1$ as a first subcomponent Mn, and at least in elements selected from the group consisting of Mg, V, Nb, Ta, B, Al, Ga, Rn, Tl, Ge, Sn and Bp as a second subcomponent (Solution).

Regarding the feature quoted above, Itakura fails to disclose the claimed average particle diameter because Itakura only briefly mentions the average particle diameter of a piezoelectric substance (paragraph [0023]). The piezoelectric element disclosed by Itakura is required to include a second subcomponent (Mg, V, Nb, Ta, B, Al, Ga, In, Tl, Ge, Mn, and Pb) for attaining excellent piezoelectric properties such as high Q_{max} . Thus, the effect of high Q_{max} is achieved by a different mechanism than in Applicants' claims.

Regarding dependent claim 12, Itakura fails to disclose "wherein said $M^{II}\text{Bi}_4\text{Ti}_4\text{O}_{15}$ type crystal is expressed by a composition formula $(\text{Ba}_{1-\alpha}\text{Sr}_\alpha\text{Ln}_\beta)\text{Bi}_\gamma\text{Ti}_4\text{O}_{15}$, and " α " satisfies

$0.1 \leq \alpha \leq 0.6$, " β " satisfies $0.05 \leq \beta \leq 0.5$ and " γ " satisfies $3.90 \leq \gamma \leq 4.30$ in said composition formula."

Itakura fails to disclose this feature because, while the Office Action cites paragraph [0035] as disclosing this feature, paragraph [0035] does not disclose the claimed features.

For the foregoing reasons, Applicants request withdrawal of the rejections.

III. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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Date: March 14, 2008

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